**Title: Midsegments and Beyond**

**Brief Overview:**

Students will use the TI-92 PLUS with Geometer's Sketchpad to explore the properties of the midsegments of a triangle and coordinate geometry connections.
NOTE: This lesson may be adapted to use with any version of Geometer's Sketchpad.

**NCTM 2000 Principles for School Mathematics:**

- **Equity:** *Excellence in mathematics education requires equity - high expectations and strong support for all students.*
- **Curriculum:** *A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades.*
- **Teaching:** *Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.*
- **Learning:** *Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.*
- **Assessment:** *Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.*
- **Technology:** *Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.*

**Links to NCTM 2000 Standards:**

- **Content Standards**

**<u>Number and Operations</u>**
The students will be able to understand numbers, ways of representing numbers, relationships among numbers, and number systems. They will be able to understand meanings of operations and how they relate to each other, as well as be able to compute fluently and make reasonable estimates.

**<u>Algebra</u>**
The students will be able to understand patterns, relations, and functions. They will be able to use mathematical models to represent and understand quantitative relationships.

**Geometry**
The students will be able to analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships. They will be able to specify locations and describe spatial relationships using coordinate geometry and other representational systems. Lastly, students will be able to use visualization, spatial reasoning, and geometric modeling to solve problems.

**Measurement**
The students will be able to understand measurable attributes of objects and the units, systems, and processes of measurement. They will be able to apply appropriate techniques, tools, and formulas to determine measurements.

**Data Analysis and Probability**
The students will be able to formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them. They will be able to develop and evaluate inferences and predictions that are based on data.

- **Process Standards**

**Mathematics as Problem Solving, Reasoning and Proof, Communication, Connections, and Representation**
These five process standards are threads that integrate throughout the unit, although they may not be specifically addressed in the unit. They emphasize the need to help students develop the processes that are the major means for doing mathematics, thinking about mathematics, understanding mathematics, and communicating mathematics.

**Links to Maryland High School Mathematics Core Learning Units:**

**Functions and Algebra**
- **1.1.1**
The students will recognize, describe, and/or extend patterns and functional relationships that are expressed numerically, algebraically, and/or geometrically.

- **1.2.1**
The students will determine the equation for a line, solve linear equations, and/or describe the solutions using numbers, symbols, and/or graphs.

**Geometry, Measurement, and Reasoning**
- **2.1.1**
The students will analyze the properties of geometric figures.

- **2.1.2**
The students will identify and/or verify properties of geometric figures using the coordinate plane and concepts from algebra.

- **2.1.4**
  The students will construct and/or draw and/or validate properties of geometric figures using appropriate tools and technology.

- **2.2.1**
  The students will identify and/or verify congruent and similar figures and/or apply equality or proportionality of their corresponding parts.

- **2.2.2**
  The students will solve problems using two-dimensional figures and/or right-triangle trigonometry.

- **2.2.3**
  The students will use inductive or deductive reasoning.

- **2.3.1**
  The students will use algebraic and/or geometric properties to measure indirectly.

- **2.3.2**
  The students will use techniques of measurement and will estimate, calculate, and/or compare perimeter, circumference, area, volume, and/or surface area of two-and three-dimensional figures and their parts.

**Data Analysis and Probability**

- **3.1.1**
  The students will design and/or conduct an investigation that uses statistical methods to analyze data and communicate results.

**Grade/Level:**

Grades 9-12, high school geometry

**Duration/Length:**

Two class periods, approximately 90 minutes each in length; and one partial period for the assessment

**Prerequisite Knowledge:**

Students should have working knowledge of the following skills:

- Operating the TI-92 Plus with Geometer's Sketchpad
- Using the definitions of midpoint, length of a segment, slope of a segment, perimeter and area
- Using the midpoint, distance and slope formulas for coordinate geometry
- Entering solutions into a student-produced response grid

- Applying the properties of the pairs of angles formed by parallel lines and a transversal
- Using a ruler and protractor

**Student Outcomes:**

Students will:

- use the TI-92 Plus with Geometer's Sketchpad to construct the midsegments of a triangle.
- use several triangles to compare the lengths of the midsegments of a triangle to the lengths of the corresponding sides.
- use several triangles to compare the slopes of the midsegments of a triangle to the slopes of the corresponding sides.
- use inductive reasoning to develop the midsegment theorem.
- use coordinate geometry to verify the midsegment theorem.
- calculate the length of a midsegment when given the length of the corresponding side.
- calculate the length of a side of a triangle when given the length of the corresponding midsegment.
- find the measure of angles formed by a triangle and its midsegments.
- compare areas of various triangles.
- apply the midsegment theorem to interpret a real-life situation.

**Materials/Resources/Printed Materials:**

- TI-92 Plus Calculators with Geometer's Sketchpad
- Rulers and Protractors
- Worksheets
- Assessment Sheet
- Answer Sheet for Worksheets and Assessment

**Development/Procedures:**

The teacher will introduce the lesson by defining the midsegment of a triangle and showing some examples. The students will use the TI-92 Plus to construct and investigate the relationships of the midsegments of a triangle to discover the parts of the midsegment theorem. The investigation will include measurements of length and slope of several triangles using Geometer's Sketchpad and calculations of coordinate geometry. The students will use the diagram of midsegments in a triangle to relate areas.

The students will complete the prepared worksheet individually or in groups (teacher's preference). At the completion of the worksheet, the teacher will lead a class discussion or have student(s) presentation(s) to verify the results.

**Assessment:**

- This is an activity-based lesson that is self-paced. The teacher should monitor the students as they complete the worksheet and assist the students as necessary.
- The class discussion should serve as a self-assessment for the student to verify their conclusions.
- A summative with questions written in the selected response, students produced response, and constructed response format will be administered.

**Extension/Follow Up:**

- The students will prove that the four triangles formed by the midsegments of a triangle are congruent to each other and similar to the original triangle.
- The students will apply their knowledge of a midsegment of a triangle to construct the midsegment of a trapezoid and determine its properties.

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NAME_____ DATE_____

**Midsegments and Beyond**

Using the Geometer's Sketchpad on the TI-92 PLUS you are going to examine the properties of the midsegments of a triangle.

Construct a triangle and its midsegments.

1. Using the point tool and holding down the 2nd key create three noncollinear points.

2. Press F3 and choose #4 (Segments); press F3 again and choose #2 (Midpoints); and then press F3 again and choose #4 (Segments). Your diagram should be of a triangle and its three midsegments.

3. Using the labeling tool label the three vertices of the large triangle A, B, and C. Label the midpoint of $\overline{AB}$ with the letter D, label the midpoint of $\overline{BC}$ with the letter E, label the midpoint of $\overline{AC}$ with the letter F.

Next, you are going to compare the lengths of the sides and the midsegments.

4. To measure the length of a segment use the arrow tool to highlight the segment to be measured and press F5 and choose #1 (Length). Measure and record in the table the lengths of the sides and their corresponding midsegments.

| Side of triangle | Length | Midsegment | Length |
|---|---|---|---|
| $\overline{AB}$ | | $\overline{EF}$ | |
| $\overline{BC}$ | | $\overline{DF}$ | |
| $\overline{AC}$ | | $\overline{DE}$ | |

5. Select a vertex of the large triangle. Press and hold the hand key to drag the vertex to a new location. Record the new lengths displayed on the calculator in the table below.

| Side of triangle | Length | Midsegment | Length |
|---|---|---|---|
| $\overline{AB}$ | | $\overline{EF}$ | |
| $\overline{BC}$ | | $\overline{DF}$ | |
| $\overline{AC}$ | | $\overline{DE}$ | |

6. Repeat the process in #5 again and record results below.

| Side of triangle | Length | Midsegment | Length |
|---|---|---|---|
| $\overline{AB}$ | | $\overline{EF}$ | |
| $\overline{BC}$ | | $\overline{DF}$ | |
| $\overline{AC}$ | | $\overline{DE}$ | |

7. Using the data recorded in the tables in #4, 5, and 6 look for a pattern between the lengths. State a relationship between the length of a midsegment and the length of its corresponding side.

_____

_____

_____

8. Using the arrow tool highlight the segment lengths and press F1 choose #3 (Delete.) DO NOT DELETE THE FIGURE.

Now you will compare the slopes of the sides and the midsegments.

9. To measure the slope of a segment use the arrow tool to highlight the segment to be measured and press F5 and choose #9 (Slope). Measure and record in the table the slopes of the sides and their corresponding midsegments.

| Side of triangle | Slope | Midsegment | Slope |
|---|---|---|---|
| $\overline{AB}$ | | $\overline{EF}$ | |
| $\overline{BC}$ | | $\overline{DF}$ | |
| $\overline{AC}$ | | $\overline{DE}$ | |

10. Select a vertex of the large triangle. Press and hold the hand key to drag the vertex to a new location. Record the new slopes displayed on the calculator in the table below.

| Side of triangle | Slope | Midsegment | Slope |
|---|---|---|---|
| $\overline{AB}$ | | $\overline{EF}$ | |
| $\overline{BC}$ | | $\overline{DF}$ | |
| $\overline{AC}$ | | $\overline{DE}$ | |

11. Repeat the process in #10 again and record results below.

| Side of triangle | Slope | Midsegment | Slope |
|---|---|---|---|
| $\overline{AB}$ | | $\overline{EF}$ | |
| $\overline{BC}$ | | $\overline{DF}$ | |
| $\overline{AC}$ | | $\overline{DE}$ | |

12. Compare the slope of a side and the slope of its corresponding midsegment.

_____
_____

13. From #12 above, what is the relationship between a side and its corresponding midsegment?

_____
_____
_____

14. Combine the results of #7 and #13 above to state the midsegment theorem.

_____
_____
_____

15. Using the arrow tool highlight the segment slopes and press F1 choose #3 to delete. DO NOT DELETE THE FIGURE.

Now you will examine the four triangles that are created by the midsegments.

16. What relationship do you suspect the areas of the four triangles have?

_____

17. To verify your conjecture, you will use Geometer's Sketchpad to measure the areas. To create and measure the area of triangle ADF, select points A, D, and F. Press F3 and choose C (Triangle Interior). Press F5 and choose #6(Area). Repeat this process for triangles DBE, DEF, and EFC. Did the measurements support your conjecture?_____

18. Select a vertex of the large triangle. Press and hold the hand key to drag the vertex to a new location. Did the relationships of the areas remain for these new triangles? _____.

19. What geometric term can be used to describe the four triangles?_____

20. What is the relationship between the area of the large triangle and the area of one of the small triangles?

_____

21. Using the arrow tool , highlight the area measurements and press F1, choose #3 (Delete). Using the arrow tool again, highlight the triangle interiors (be careful not to highlight the points and segments) and press F1, choose #3 (Delete).
DO NOT DELETE THE FIGURE.

Finally you will verify the midsegment theorem using coordinate geometry.

22. Press F6 choose #4 to show the grid. Select point (1,0) and drag slowly towards the origin. This will change the scale of the axes. Stop when the x-axis shows 10 and –10.

23. Select points A, B, and C, press F5 choose D (analytic), and then choose #1 (Coordinates).

24. Press F6 choose #5 (Snap To Grid). Select point A and using the hand tool, drag the point to show integral coordinates. Repeat for points B and C.

25. Record the coordinates of points A, B, and C below.

A = (  ,  )  B = (  ,  )  C = (  ,  )

26. State the formula for finding the midpoint of a segment _____

27. Using the formula and the coordinates of points A, B, and C find the coordinates of the midpoints of the sides of the triangle ABC and record below. (Show all work)

D = (  ,  )  E = (  ,  )  F = (  ,  )

Verify your results on the calculator using the process in #23.

28. State the distance formula for coordinate geometry._____

29. Using the formula and the coordinates of points A, B, C, D, E, and F , find the lengths of the sides of the triangle and the lengths of the midsegments. Show all work on a separate sheet of paper. Record the lengths in the table below.

| Side of triangle | Length | Midsegment | Length |
|---|---|---|---|
| $\overline{AB}$ | | $\overline{EF}$ | |
| $\overline{BC}$ | | $\overline{DF}$ | |
| $\overline{AC}$ | | $\overline{DE}$ | |

30. Do your results agree with the midsegment theorem? _____

31. State the slope formula when given two points. _____

32. Using the slope formula and coordinates of points A, B, C, D, E, and F, calculate the slopes of the sides and midsegments. Show all work on a separate sheet of paper. Record the slopes in the table below.

| Side of triangle | Slope | Midsegment | Slope |
|---|---|---|---|
| $\overline{AB}$ | | $\overline{EF}$ | |
| $\overline{BC}$ | | $\overline{DF}$ | |
| $\overline{AC}$ | | $\overline{DE}$ | |

33. Do your results agree with the midsegment theorem? _____

You have now stated and verified the midsegment theorem for triangles using Geometer's Sketchpad and coordinate geometry. Review your results and be ready to apply the properties in various types of problems.

NAME **Teacher Key** DATE_____

**Midsegments and Beyond**

Using the Geometer's Sketchpad on the TI-92 PLUS you are going to examine the properties of the midsegments of a triangle.

Construct a triangle and its midsegments.

1. Using the point tool and holding down the 2nd key create three noncollinear points.

2. Press F3 and choose #4 (Segments); press F3 again and choose #2 (Midpoints); and then press F3 again and choose #4 (Segments). Your diagram should be of a triangle and its three midsegments.

3. Using the labeling tool label the three vertices of the large triangle A, B, and C. Label the midpoint of $\overline{AB}$ with the letter D, label the midpoint of $\overline{BC}$ with the letter E, label the midpoint of $\overline{AC}$ with the letter F.

Next, you are going to compare the lengths of the sides and the midsegments.

4. To measure the length of a segment use the arrow tool to highlight the segment to be measured and press F5 and choose #1 (Length). Measure and record in the table the lengths of the sides and their corresponding midsegments.
**Lengths will vary, but should have a 2 to 1 ratio.**

| Side of triangle | Length | Midsegment | Length |
|---|---|---|---|
| $\overline{AB}$ | | $\overline{EF}$ | |
| $\overline{BC}$ | | $\overline{DF}$ | |
| $\overline{AC}$ | | $\overline{DE}$ | |

5. Select a vertex of the large triangle. Press and hold the hand key to drag the vertex to a new location. Record the new lengths displayed on the calculator in the table below.
**Lengths will vary, but should have a 2 to 1 ratio.**

| Side of triangle | Length | Midsegment | Length |
|---|---|---|---|
| $\overline{AB}$ | | $\overline{EF}$ | |
| $\overline{BC}$ | | $\overline{DF}$ | |
| $\overline{AC}$ | | $\overline{DE}$ | |

6. Repeat the process in #5 again and record results below.
**Lengths will vary, but should have a 2 to 1 ratio.**

| Side of triangle | Length | Midsegment | Length |
|---|---|---|---|
| $\overline{AB}$ | | $\overline{EF}$ | |
| $\overline{BC}$ | | $\overline{DF}$ | |
| $\overline{AC}$ | | $\overline{DE}$ | |

7. Using the data recorded in the tables in #4, 5, and 6 look for a pattern between the lengths. State a relationship between the length of a midsegment and the length of its corresponding side.

**The length of a midsegment is one half the length of its corresponding side . (or) The length of a midsegment and the length of its corresponding side are in a 1 to 2 ratio.**

8. Using the arrow tool highlight the segment lengths and press F1 choose #3 (Delete.) DO NOT DELETE THE FIGURE.

Now you will compare the slopes of the sides and the midsegments.

9. To measure the slope of a segment use the arrow tool to highlight the segment to be measured and press F5 and choose #9 (Slope). Measure and record in the table the slopes of the sides and their corresponding midsegments.

**Slopes will vary, but should be equal.**

| Side of triangle | Slope | Midsegment | Slope |
|---|---|---|---|
| $\overline{AB}$ | | $\overline{EF}$ | |
| $\overline{BC}$ | | $\overline{DF}$ | |
| $\overline{AC}$ | | $\overline{DE}$ | |

10. Select a vertex of the large triangle. Press and hold the hand key to drag the vertex to a new location. Record the new slopes displayed on the calculator in the table below.

**Slopes will vary, but should be equal.**

| Side of triangle | Slope | Midsegment | Slope |
|---|---|---|---|
| $\overline{AB}$ | | $\overline{EF}$ | |
| $\overline{BC}$ | | $\overline{DF}$ | |
| $\overline{AC}$ | | $\overline{DE}$ | |

11. Repeat the process in #10 again and record results below.

**Slopes will vary, but should be equal.**

| Side of triangle | Slope | Midsegment | Slope |
|---|---|---|---|
| $\overline{AB}$ | | $\overline{EF}$ | |
| $\overline{BC}$ | | $\overline{DF}$ | |
| $\overline{AC}$ | | $\overline{DE}$ | |

12. Compare the slope of a side and the slope of its corresponding midsegment.
**The slope of a midsegment is equal to the slope its corresponding side. (or)**
**The slope of a midsegment and the slope of its corresponding midsegment are in a 1 to 1 ratio.**

13. From #12 above, what is the relationship between a side and its corresponding midsegment?

**The midsegment is parallel to its corresponding side.**

14. Combine the results of #7 and #13 above to state the midsegment theorem.

**The midsegment of a triangle is half the length of its corresponding side and is parallel to its corresponding side.**

15. Using the arrow tool highlight the segment slopes and press F1 choose #3 to delete. DO NOT DELETE THE FIGURE.

Now you will examine the four triangles that are created by the midsegments.

16. What relationship do you suspect the areas of the four triangles have?
**The areas of the four triangles are equal.**

17. To verify your conjecture, you will use Geometer's Sketchpad to measure the areas. To create and measure the area of triangle ADF, select points A, D, and F. Press F3 and choose C (Triangle Interior). Press F5 and choose #6(Area). Repeat this process for triangles DBE, DEF, and EFC. Did the measurement support your conjecture? **Yes**

18. Select a vertex of the large triangle. Press and hold the hand key to drag the vertex to a new location. Did the relationships of the areas remain for these new triangles? **Yes**.

19. What geometric term can be used to describe the four triangles? **Congruent**

20. What is the relationship between the area of the large triangle and the area of one of the small triangles?

**The area of the large triangle is four times the area of the smaller triangles.**

21. Using the arrow tool , highlight the area measurements and press F1, choose #3 (Delete). Using the arrow tool again, highlight the triangle interiors (be careful not to highlight the points and segments) and press F1, choose #3 (Delete).
DO NOT DELETE THE FIGURE.

Finally you will verify the midsegment theorem using coordinate geometry.

22. Press F6 choose #4 to show the grid. Select point on (1,0) and drag slowly towards the origin. This will change the scale of the axes. Stop when the x-axis shows 10 and –10.

23. Select points A, B, and C, press F5 choose D (analytic), and then choose #1 (Coordinates).

24. Press F6 choose #5 (Snap To Grid). Select point A and using the hand tool, drag the point to show integral coordinates. Repeat for points B and C.

25. Record the coordinates of points A, B, and C below.

**Coordinates will vary.**

A = ( , ) B = ( , ) C = ( , )

26. State the formula for finding the midpoint of a segment $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$

27. Using the formula and the coordinates of points A, B, and C find the coordinates of the midpoints of the sides of the triangle ABC and record below. (Show all work)

**Work and coordinates will vary.**

D = ( , ) E = ( , ) F = ( , )

Verify your results on the calculator using the process in #23.

28. State the distance formula for coordinate geometry. $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

29. Using the formula and the coordinates of points A, B, C, D, E, and F , find the lengths of the sides of the triangle and the lengths of the midsegments. Show all work on a separate sheet of paper. Record the lengths in the table below.

**Lengths will vary, but should have a 2 to 1 ratio.**

| Side of triangle | Length | Midsegment | Length |
|---|---|---|---|
| $\overline{AB}$ | | $\overline{EF}$ | |
| $\overline{BC}$ | | $\overline{DF}$ | |
| $\overline{AC}$ | | $\overline{DE}$ | |

30. Do your results agree with the midsegment theorem? **Yes**

31. State the slope formula when given two points. $m = \frac{y_2 - y_1}{x_2 - x_1}$

32. Using the slope formula and coordinates of points A, B, C, D, E, and F, calculate the slopes of the sides and midsegments. Show all work on a separate sheet of paper. Record the slopes in the table below.

**Slope will vary, but should be equal.**

| Side of triangle | Slope | Midsegment | Slope |
|---|---|---|---|
| $\overline{AB}$ | | $\overline{EF}$ | |
| $\overline{BC}$ | | $\overline{DF}$ | |
| $\overline{AC}$ | | $\overline{DE}$ | |

33. Do your results agree with the midsegment theorem? **Yes**

You have now stated and verified the midsegment theorem for triangles using Geometer's Sketchpad and coordinate geometry. Review your results and be ready to apply the properties in various types of problems.

# Assessment for Midsegments and Beyond

## Teacher's Guide

### Introduction

The purpose of the assessment activity is to determine if the students mastered the objectives that were taught. The assessment should be given after the class discussion as the end of the lesson.

#### Objectives Covered

Students will be able to:

- state the midsegment theorem.
- calculate the lengths and slopes of the sides of a triangle and the midsegments.
- find the measure of angles based on properties of the midsegment theorem.
- apply the midsegment theorem to interpret a real-life situation.

#### Tools/Materials Needed for Assessment

- Assessment sheet
- Ruler and Protractor

### Administering the Assessment

Students will complete the assessment independently. They will record their answers directly on the assessment sheet. A scoring key is included.

**Assessment**

NAME_____ DATE_____

**Midsegments and Beyond**

1. Write the midsegment theorem.

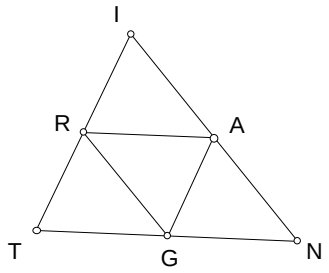
_____

_____

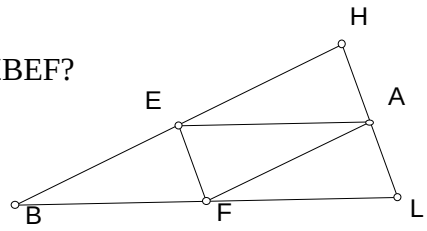
_____

Selective Response Questions
Directions: Circle the letter of the correct solution.

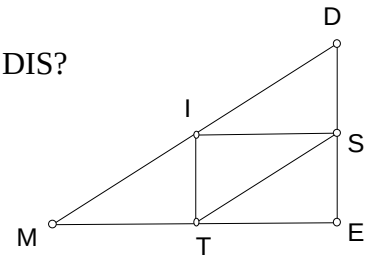
2. In triangle TIN, the midpoints of the sides are R, A, and G.
   If TI = 5, TN = 6 and IN = 7, what is the length of AG?
   a) 2.5
   b) 3
   c) 3.5
   d) 4




3. In triangle HLB, the midpoints of the sides are E, A, and F.
   If ∠B =35°, ∠H =85°, and ∠L =60°, what is the measure of ∠BEF?
   a) 35°
   b) 60°
   c) 85°
   d) 90°

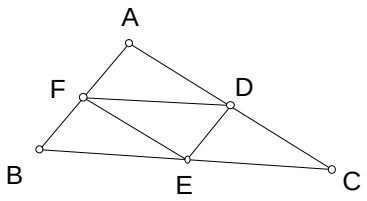



4. In triangle MED, the midpoints of the sides are I, T, and S.
   If DE = 18, ME = 24, MD = 30, what is the perimeter of triangle DIS?
   a) 18
   b) 36
   c) 60
   d) 72



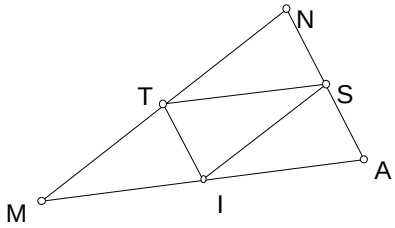
Student Produced Response Questions

5. In triangle ABC, the midpoints of the sides are F, E, and D.
If DE = 6.2, FE = 13.3, and FD = 14.8, what is the length of AC?



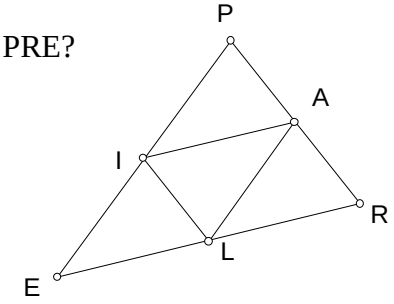

Answer: _____

6. In triangle NAM, the midpoints of the sides are T, I and S.
If the slope of segment MN is 1.5, the slope of segment TS is .2,
what is the slope of segment SI?



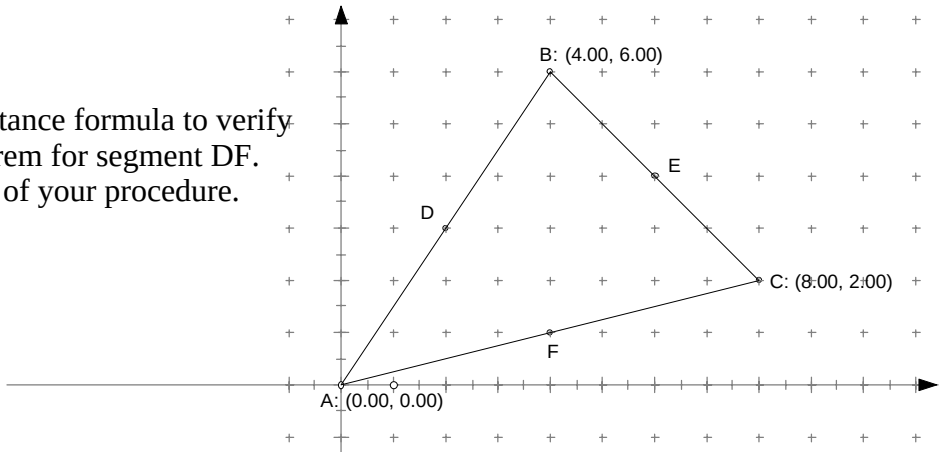

Answer: _____

7. In triangle PRE, the midpoints of the sides are I, L and A.
If IA = 35, IL = 27, and LA = 32, what is the perimeter of triangle PRE?

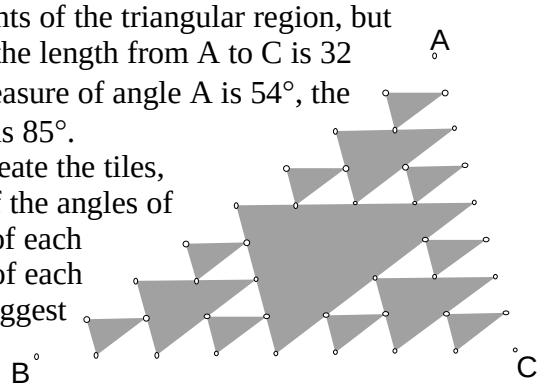



Answer: _____

8. Use the slope and distance formula to verify the midsegment theorem for segment DF. Write an explanation of your procedure.




9. Your geometry class has been asked to help the art department add tiles to a triangular region on the floor in the front lobby of the school. The design that has been selected is a large triangle made up of 3 different size smaller triangles called the Sierpinski Triangle. It is created by first drawing the midsegment of the large triangle and shading in the triangle formed by the midsegments. This process is continued for the non-shaded triangles two more times (diagram **not drawn to scale**). The art department has taken the following measurements of the triangular region, but needs your help. The length from A to B is 48 inches, the length from A to C is 32 inches and the length from B to C is 40 inches. The measure of angle A is 54°, the measure of angle B is 41°, and the measure of angle C is 85°. The art department knows these dimensions and will create the tiles, but they need the length of the sides and the measure of the angles of each size tile. Your task is to calculate the dimensions of each size tile. You must also make a labeled scale drawing of each size tile to send to the art department. You may also suggest a color scheme.




Write an explanation of how you determined your dimensions.

Include your labeled scale drawings below or on the opposite side of this sheet.

**Assessment**

NAME **Teacher Key 15 points possible** DATE_____

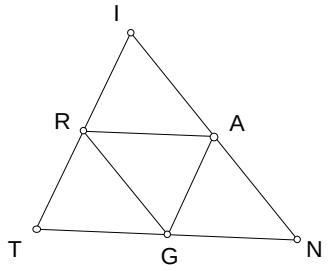
Midsegments and Beyond

1. Write the midsegment theorem.

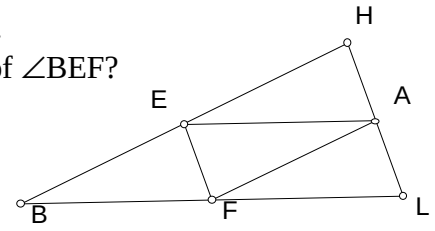
**The student included the one half length relationship and parallel relationship of midsegment to the corresponding side. (1 point)**

Selective Response Questions
Directions: Circle the letter of the correct solution.

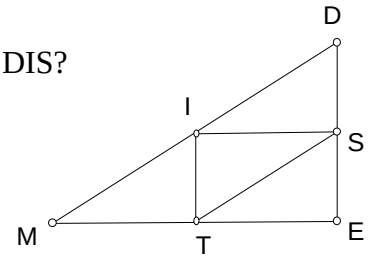
2. In triangle TIN, the midpoints of the sides are R, A, and G.
   If TI = 5, TN = 6 and IN = 7, what is the length of AG?
   a) 2.5 **(1 point)**
   b) 3
   c) 3.5
   d) 4




3. In triangle HLB, the midpoints of the sides are E, A, and F.
   If ∠B =35°, ∠H =85°, and ∠L =60°, what is the measure of ∠BEF?
   a) 35°
   b) 60°
   c) 85° **(1 point)**
   d) 90°

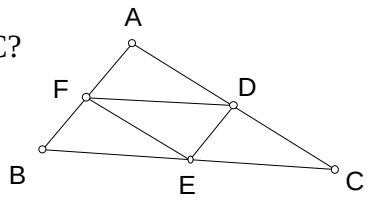



4. In triangle MED, the midpoints of the sides are I, T, and S.
   If DE = 18, ME = 24, MD = 30, what is the perimeter of triangle DIS?
   a) 18
   b) 36 **(1 point)**
   c) 60
   d) 72



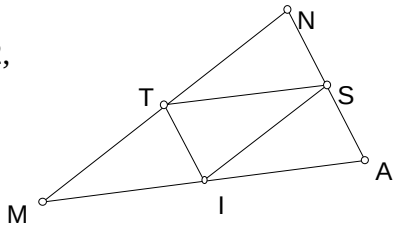
Student Produced Response Questions

5. In triangle ABC, the midpoints of the sides are F, E, and D.
If DE = 6.2, FE = 13.3, and FD = 14.8, what is the length of AC?



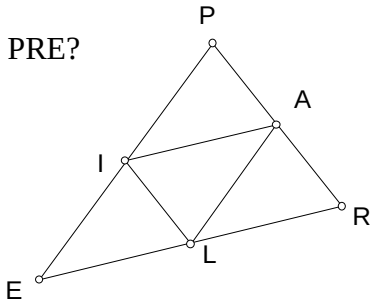

Answer: 26.6 **(1 point)**

6. In triangle NAM, the midpoints of the sides are T, I and S.
If the slope of segment MN is 1.5, the slope of segment TS is .2,
what is the slope of segment SI?



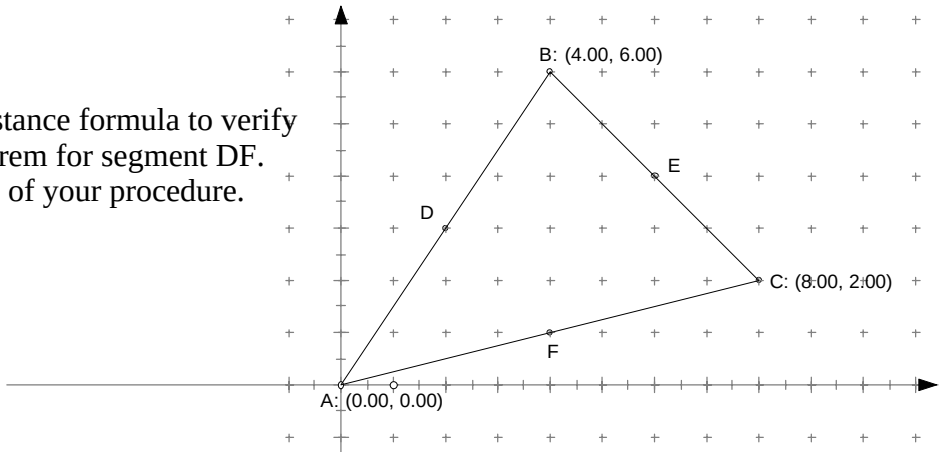

Answer: 1.5 **(1 point)**

7. In triangle PRE, the midpoints of the sides are I, L and A.
If IA = 35, IL = 27, and LA = 32, what is the perimeter of triangle PRE?



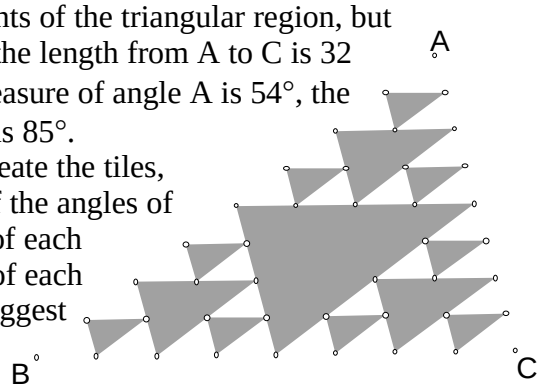

Answer: 188 **(1 point)**

8. Use the slope and distance formula to verify the midsegment theorem for segment DF. Write an explanation of your procedure.




**(4 points) see scoring guide on next page**

9. Your geometry class has been asked to help the art department add tiles to a triangular region on the floor in the front lobby of the school. The design that has been selected is a large triangle made up of 3 different size smaller triangles called the Sierpinski Triangle. It is created by first drawing the midsegment of the large triangle and shading in the triangle formed by the midsegments. This process is continued for the non-shaded triangles two more times (diagram **not drawn to scale**). The art department has taken the following measurements of the triangular region, but needs your help. The length from A to B is 48 inches, the length from A to C is 32 inches and the length from B to C is 40 inches. The measure of angle A is 54°, the measure of angle B is 41°, and the measure of angle C is 85°. The art department knows these dimensions and will create the tiles, but they need the length of the sides and the measure of the angles of each size tile. Your task is to calculate the dimensions of each size tile. You must also make a labeled scale drawing of each size tile to send to the art department. You may also suggest a color scheme.




Write an explanation of how you determined your dimensions.

**(4 points) see scoring guide on next page**

Include your labeled scale drawings below or on the opposite side of this sheet.

**Scoring Guide for Constructed Response Questions**

***Problem #8***

**4:** The student explains finding the coordinates of point D (2, 3) and point F (4, 1). The student correctly finds the slope of segment DF to be –1 and the slope of BC to be –1 and compares them. The student correctly finds the length of DF to be $2\sqrt{2} \approx 2.83$ and the length of BC to be $4\sqrt{2} \approx 5.66$ and compares them.

**3:** The student correctly finds the slope of segment DF to be –1 and the slope of BC to be –1 and compares them. The student correctly finds the length of DF to be $2\sqrt{2} \approx 2.83$ and the length of BC to be $4\sqrt{2} \approx 5.66$ and compares them.

**2:** The student either correctly finds the slope of segment DF to be –1 and the slope of BC to be –1 and compares them or correctly finds the length of DF to be $2\sqrt{2} \approx 2.83$ and the length of BC to be $4\sqrt{2} \approx 5.66$ and compares them.

**1:** The student attempts to solve the problem using the slope and distance formulas, but is unable to find correct values.

**0:** The student does not attempt to solve problem.

***Problem #9***

**4:** The student correctly finds the dimensions of the three tiles and explains method. (large tile 24in, 20in, 16in; medium tile 12in, 10in, 8in; small tile 6, 5, 4 angles 85°, 54°, 41°) The student mentions the midsegment theorem in their explanation. The student creates a labeled scale drawing of all three tiles.

**3:** The student correctly finds the dimensions of two of the three tiles and explains method. The student mentions the midsegment theorem in their explanation. The student creates labeled drawings of the tiles that appear to be similar to each other, but are not to scale.

**2:** The student correctly finds the dimensions of one of the three tiles and explains the method. The student creates labeled drawings of tiles that are not to scale or similar to each other.

**1:** The student attempts to find the dimensions of the tiles, but is unable to find the correct values. The student attempts the drawings.

**0:** The student does not attempt to solve the problem.